SVKM's
D. J. Sanghvi College of Engineering

Program: B.Tech in Electronics Engineering **Academic Year: 2022** **Duration: 3 hours**
Date: 12.01.2023
Time: 10:30 am to 01:30 pm
Subject: Advanced Control Systems (Semester V) **Marks: 75**

Instructions: Candidates should read carefully the instructions printed on the question paper and on the cover page of the Answer Book, which is provided for their use.

(1) This question paper contains two pages.
(2) All Questions are Compulsory.
(3) All questions carry equal marks.
(4) Answer to each new question is to be started on a fresh page.
(5) Figures in the brackets on the right indicate full marks.
(6) Assume suitable data wherever required, but justify it.
(7) Draw the neat labelled diagrams, wherever necessary.
(8)

Question No.		Max. Marks
Q1 (a)	Express the following transfer function in the OCF form. $$2\frac{d^3 y}{dt^3} + 4\frac{d^2 y}{dt^2} + 6\frac{dy}{dt} + 3y = 4u$$	[10]
	OR	
Q1 (a)	Obtain the transfer function from the given state space model. $$\begin{bmatrix} \dot{x_1} \\ \dot{x_2} \end{bmatrix} = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 2 \\ 5 \end{bmatrix}u$$ $$y = \begin{bmatrix} 1 & 2 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$	[10]
Q1 (b)	State and prove the properties of the state transition matrix	[05]
Q2 (a)	A LTI system is characterized by the state variable model. Comment on the controllability (state and output) and observability of the system. $$A = \begin{bmatrix} 0 & 0 & 0 \\ 1 & 0 & -3 \\ 0 & 1 & -4 \end{bmatrix} \quad B = \begin{bmatrix} 40 \\ 10 \\ 0 \end{bmatrix} \quad C = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix}$$	[10]
Q2 (b)	Explain controllability and observability with its necessary condition for stability.	[05]
	OR	

Q2 (b)	List the advantages of the state space model over the transfer function model.	[05]
Q3 (a)	Explain the concept of sampling in a digital control system. Explain the concept of reconstruction of discrete time signal.	[10]
Q3 (b)	Compare discrete time signal with digital signal.	[05]
	OR	
Q3 (b)	Explain the advantages and disadvantages of a digital control system.	[05]
Q4 (a)	Explain the impulse invariance discretization method.	[10]
	OR	
Q4 (a)	The open-loop pulse transfer function of a unity feedback control system is given by $G(z) = \frac{0.7870z}{(z-1)(z-0.6065)}$ Determine the critical value of K for a sampling period of T = 1 sec. Also sketch the root locus plot.	[10]
Q4 (b)	What is sampling? Explain the different types of sampling.	[05]
Q5 (a)	**Solve any two.**	
	i. Model Predictive Control	[05]
	ii. Robust Control	[05]
	iii. Lag Compensator	[05]
	iv. Lead Compensator	[05]
Q5 (b)	Explain the need for compensation. Explain the different types of compensation.	[05]